2016-9

A Socio-Technological Perspective of Blended Problem-based Learning

Roisin Donnelly

Technological University Dublin, roisin.donnelly@tudublin.ie

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Dr Roisin Donnelly

Learning, Teaching and Technology Centre
Dublin Institute of Technology

Abstract

In recent years, the discourse regarding the developing and utilisation of information related digital technologies has flowed between a notion of autonomous technology and social constructivst perspectives. It is almost obvious that in real life both the social structures affect the development and the design of digitized information technology, and digitized information technology on the other side affect the social structures and how we use them. In higher education, digitized information technologies do not develop in isolation and similarly, the social structures in our classrooms do not develop free from technological influence. The Internet and associated digitized learning technologies cannot be regarded as an invention completely out of the context of all other developments in communication, culture and social organisation which have preceded them and made it both possible and necessary: there are clear interactions occurring between them but also challenges in how they unfold and operate together. In addition to technological issues for teachers and academic developers, there are problems that arise during the change process from a traditional delivery mechanism, such as the lecture, to an alternative pedagogy such as a problem-based educational model.

This paper addresses the need for an analysis of interactions taking place in the blending of online and face-to-face problem-based learning tutorials in the higher education classroom. There is a specific focus on the socio-technological relationships of the academic staff who are engaged in professional/faculty development in higher education.

KEYWORDS

Blended learning; Constructivist; Digital diversity; eLearning design; interaction; Problem-based learning; Professional Development; Socio-technological perspectives; Transformative pedagogies

Introduction

From a learner's perspective, the Web is both an environment and a set of modes of interaction between learners. Due to its complexity, effective use of the Web requires learners to interact socially. Much of what we do in the Web is to conduct information exchange, reverberate each other's discoveries, and utilise them to construct our own maps and signposts with each new set of information. This depends to a considerable extent on the interaction between individuals. A social network is necessary to bind together the nodes of the Web. The Web is thus embedded both in a technological Web (the protocols, data lines, modems, computer hubs and computer terminals which constitute the Internet) and a Web of social interactions which construct and shape the understanding, use, and thus usefulness of it.

Popular approaches to the problem of describing and explaining the evolution of technological and social systems is by considering them as Bijker *et al* (1987) explains as systems of seamlessly interpenetrating social and technical components, often described in terms of socio-technical systems or networks. Technologies are social, because they are produced by, facilitate, and shape human interaction. Correspondingly, the Web is a technology with social and technical dimensions and implications. Consistent with this theory, it mediates and contributes to social as well as technological change. The stance taken in this paper between technologies and the social aspect of learning in PBL is that they are constantly informing each other over time.

As it would appear that eLearning products are often lauded on the basis of their constructivist approach to learning, but in reality sustained inter-student contact and discussion can be difficult, an underlying purpose of the research in this paper is to show how interactional analysis helps in understanding the potential for a such transformative pedagogy as blended PBL.

There is a strong focus on the design of blended PBL throughout this paper, synthesizing eLearning with the more traditional forms of PBL, and drawing together the 'e' with the classroom, the laboratory, the seminar and the PBL tutorial setting. Drawing upon on relevant literature, a model of professional development based upon the socio-technological transformations possible within blended PBL is offered.

Background

Jochems *et al*. (2004) have highlighted that change is part and parcel of the field of higher education, and societal and technological developments play their part in effecting it. Meyers (2006) has made a case for Internet-based courses being well suited for transformative pedagogy. He argues that online class discussions tend to be more collegial and informal than those that occur face-to-face, and thereby challenge conventional notions of power and authority in the higher education classroom. McAuliffe and Lovell (2000) also propose that such online discussions result in a relatively egalitarian environment and this is appropriate for teaching approaches that critically examine societal patterns of power and dominance.

The research agenda on transformative pedagogies is wide-ranging, referring not only to strategies or styles of instruction but also to the facilitation and management of sustainable transformations, whether individual, social, structural or institutional. From a definitional perspective, descriptions of transformative pedagogy originated in the adult education literature and Myers (2006) believes it has been regarded as an approach to teaching that encourages students to grapple with disorienting dilemmas, critically examine their assumptions related to the contradictory information, seek out additional perspectives, and ultimately acquire new knowledge, attitudes and skills in light of these reflections – all in order to experience personal and intellectual growth.

The stance adopted in this paper is that the transformative dimension of pedagogies deserves to be clarified, revisited and arguably bent with regard to the responsibility of academic developers and educators alike, to transcend their traditional role and expand

the scope of their work towards an active participation to knowledge advancement. The intentions of transformative educators have not changed much in the last decades but the context of their action is no longer the same. In the context of today's knowledge-driven, technology-oriented society, it is important to take advantage of the possibilities offered by eLearning to support innovative conceptualizations of problem-based learning. Calvert (2006), amongst others, has argued that learning technologies have been recently presented as the panacea to democratise education, improve the quality of learning, advocating peer-to-peer collaboration and giving learners a greater sense of autonomy and responsibility for learning.

In terms of the overall needs of this research, the literature can provide information about factors influencing the success or failure of eLearning, PBL and blended initiatives in higher education; it provided a finely wrought delineation of transformative pedagogy that can be applied to technology-mediated environments and uncovered a number of credible studies that had an academic development context and a resulting focus on the learning and practice of academic staff in higher education. Although some studies have been couched in an exaggerated and uncritical language, the potency of blending PBL and eLearning has been reported. While we are clearly in need of more research and even though what researchers have found may not be surprising in many cases, they are collectively in favour of strategies that incorporate digitized technology into an environment that is both student-centred and organized in a format that promotes PBL strategies and philosophies. In summary, while the literature is rich in both theoretical and empirical work on both eLearning and PBL, there is insufficient guidance to be had on key issues that would face the higher education academic tutor who is setting out on a process of developing a blend of eLearning and PBL for professional/faculty development.

The research study on blended PBL is based on the hypothesis that interaction between participants in the PBL group is the key element to a successful blended learning experience for all involved. The hypothesis is based on a sociological understanding of

one of the dimensions of interaction for describing groups, coined by Wagner (2006) as 'interactions as transactions'.

Interaction has been and continues to be one of the most hotly debated constructs in the realms of distance and eLearning, instructional design and academic transformation to name but three. The ability to interact - with tutors, students, content interfaces, features, code, channels and environments - can be argued to be analogous to being connected. Whilst this may appear simplistic, for technology-mediated learning, interaction is undoubtedly a key value proposition. It continues to be perceived as the defining attribute for quality and value in a blended learning experience. Interactivity is the core of learning, and is evident at all levels of engagement. However, the term *interactivity* is used so loosely that in the fields of eLearning and blended learning, it has become almost synonymous with the notion of learning itself. This paper proposes that by bringing the concept into sharper focus, real insight will be gained into the nature of blended PBL. Interaction in the context of this study will be explored at three levels: interaction with concepts, tasks and people (peer learners and tutors). These three levels have been previously represented in a popular framework for interactive learning by Mayes and Fowler (1999). However it is suggested that a case can be made for proposing a new dimension of interaction that focuses on the blended PBL interaction activity experience. The decision for this was based upon recognition that transformative learning is a complex process of interaction between people, the tools they use and the context in which they are embedded.

Issues, Controversies, Problems

This research recognises that definitions of transformative learning are problematic and few take account of the radical sociocultural changes resulting from the introduction of digital technologies such as the Internet and wireless connectivity. The transformative nature of the learning in this module is about change in beliefs and attitudes towards eLearning and PBL. In this current study, the learning is not just at the levels of knowledge and skills acquisition in blended PBL. It is argued that the participants need to radically transform their approach to thinking and learning to both eLearning and

problem-based learning in order to maximise the benefits offered by the blend. Presenting new information to them on this area is not enough to guarantee optimal learning; they must recognise the limitations of their current knowledge and perspectives. What is required is a true transformation of the participants' existing knowledge.

It is important to consider if educational transformation can only be obtained by designing for it explicitly, as is the case in this current study. One can argue for a balance in looking at gradual cumulative benefits versus transformation. A number of previous studies, including one by Whitelaw *et al*. (2004), on academic staff participating in instructional development, have shed light on changes in attitudes towards technology-enhanced instruction and change in pedagogical style in relation to the presence of transformative learning experiences. More recently, Kitchenham (2006) conducted a study with 10 teachers who experienced perspective transformation as they learned to use educational digitized technologies and integrate it into their classroom teaching. This holds interest for this current study which is exploring perspective transformation at an individual level for a small number of academic staff using learning technologies with a student-centred pedagogy such as PBL; the transformation in perspective is explored in how they approach learning on the module and how they carry it through to their own classroom practice.

Solutions and Recommendations: Transformative Pedagogy of Blended PBL

Before exploring the blending of PBL and eLearning, it is useful to begin with a description of the PBL tutorial process itself. Much has already been written about the PBL tutorial process and Myers Kelson *et al*. (2000, p168) have been useful for providing a detailed description of PBL unfolding. In this approach, students work in small groups to negotiate what Merrill (2001) terms a common understanding of the problem, identify areas that need to be researched, form hypotheses and fully develop a solution that they can present to others. One of the common criticisms of PBL is that, because it moves away from the traditional lecture, reading and discussion model, less subject matter may be covered. The good news is that effective eLearning environments have already recognized this shift as a beneficial one and have embraced a new pedagogy that puts the

student in the driver's seat on the journey that is their learning path. In the PBL approach, the content (e.g. traditional lecture materials or assigned readings) is sought out as a part of the larger process of solving a problem. Students decide, often with the help of the tutor, what they need to know in order to successfully devise a solution and then actively seek it out (amongst resources that may or may not be provided by the tutor). In this way, students are actually defining their own learning outcomes and the knowledge acquisition becomes a means to an end, rather than the end goal itself.

Donnelly (2006) suggests that PBL would be considered by many educators as an innovative approach to teaching and learning. Internationally the best known models are the seven-jump model (Woods, 1994) and the eight-step model (Schmidt, 1983), which are both based on Barrows (1980) definition of the PBL process. These models emphasise the aspects of constructivism, problem-solving and individual learning; Uden and Beaumont (2006) maintain that these processes are constantly under development, with a variety of different versions being applied in different contexts globally. The first applications in the Republic of Ireland, like elsewhere, were in medical education. Subsequently, it has been utilised in fields ranging from business to law and engineering.

The basic principle supporting the concept of PBL is older than formal education itself, namely that learning is initiated by a posed problem, query, or puzzle that the learner wants to solve (Boud and Feletti, 1991). In this problem-based approach, a complex, real problem was given to motivate the participants to identify and research concepts and principles they needed to know in order to progress through the problem. Raising awareness of the issue of pedagogical use of digitized learning technology and its practice within problem-based learning is important. Pedagogically, design issues can centre on whether the integration of the learning technology would make the participants' learning in the problems more accessible and whether it would promote improved learning.

This study examines the ways in which eLearning technology can be used to support PBL and in doing so analyses the transformative nature of such learning for academic staff in higher education. By the year 2000, serious consideration was being given in Ireland, as

elsewhere, to the implications of another form of educational delivery *viz.* eLearning. The Higher Education Authority (HEA) stated that Ireland should play a pro-active role in what it called 'Internet-based learning'. It acknowledged the country's leading role in the Information Technology (IT) industry and went on to point out that it would be consistent for Ireland to explore the potential for eLearning (Thornhill, 2000).

An exploration of eLearning reveals that it represents a convergence of several fields, including education, computer science, design and media studies. Its multidisciplinary nature and rapid evolution has led to individual researchers taking different approaches to research, deriving from their individual contexts, with little reflection on the appropriateness of their approach. The literature abounds with accounts of how initially eLearning was led by the digitized technologies rather than by learning theories and pedagogies, but over the past several years, there has been a significant redressing in the balance by combining the best traditional teaching with eLearning models to create blended learning. "It is not just another add-on, but a technology that is transforming our educational institutions and how we conceptualise and experience teaching and learning" (Garrison and Anderson, 2003, p122).

Moursund (2003, pix) contends that one of the constants of digitized technology and education is that they are always changing: newer digitized technology comes along and alternative educational practices are developed. It is important to maintain the commitment to the theories of problem-based learning but reflect the changing nature of technology and emphasise new educational practices. Laurillard (1993) and Collis and Moonen (2001) are some of the most well-known scholars from the educational technology literature which support the view that pedagogy, not digitized technology, should determine how best it is used.

PBL is essentially about the facilitation of learning but it has been also been described as a transformative strategy, which aims for renewing the learning and teaching culture (Portimojärvi and Vuoskoski, 2006). Whilst not advocating a crusading strategy for the introduction of blended PBL to academic development, learning on this module is seen as

a participative, creative, collaborative and above all, transformative process. Within this programme of professional development for academic staff, there is a community of inquiry comprising open and sustained discourse dedicated to developing competencies such as critical and creative thinking, written and verbal communications skills and interpretive and evaluation abilities. It is argued that this higher learning experience is compromised with the persistent reliance on the lecture, rather than on interaction as the key element and standard of a quality learning experience in higher education. The research of Oliver *et al*. (2006) suggests

> *a strong need for researchers to continue to explore authentic problem-centred learning design and investigate design strategies that will guide instructors and designers in the appropriate forms of blended learning they choose to employ*. (p513).

Kirkley and Kirkley (2006, p534) report that there is a need for innovative learning environments using appropriate learning methodologies that can support learners with complex problem solving and development of greater expertise. This can be attributed to digitized technology continuing to invoke major changes in society and HEIs. As the creation of new affordances such as Internet-based tools mature and coalesce into new configurations, this creates conditions where engagement with knowledge and what it means to be a learner are being constantly challenged. They believe that PBL meets the need for creating such complex and authentic learning environments. By centering the learning situation in real-world problems, Reiser (2002) believes we have the opportunity to acculturate the learner into the processes, practices and language of a specific domain. In order to blend learning effectively, we need to better understand how to use learning methodologies such as PBL, strategies such as interactive discussion and various technologies such as face-to-face and online learning in order to make learning effective. However, as new technologies continue to emerge, teachers must expand their notion of blended learning and constantly evaluate how to use methodologies, strategies and technologies in order to create highly innovative learning environments.

This blended problem-based learning module, as Boud and Prosser (2002) advocate, takes a learning design approach that looks at the learning goals and aligns them with

teaching and learning activities and assessments, thereby ensuring the integration and appropriate use of digitized technology. However Lefoe and Hedburg (2006) suggest that delivering and accessing a blended program requires new ways of thinking about teaching and learning. Valsamidis (2006) suggests that focusing on the delivery of material instead of on the much more crucial interaction of the material with the learner, mediated by a tutor through a rich channel of communication, results in a mismatch in how some academic development is designed.

However in higher education, constraints such as class duration, size, location and availability of digitized technology can provide a formidable barrier to making transformational changes to learning. In spite of this, West and Graham (2005) have reported that a growing number of academics are experimenting with innovative technology-mediated approaches to teaching using tools for simulations, visualization, communication and feedback, all of which are transforming the ways that their students learn. McConnell (2006) asserts that when students interact with each other and available resources, they change. Spector (2000) believes such transformations may occur in their abilities, attitudes, beliefs, capabilities, knowledge and understanding, mental models and skills. These changes may reside in the individual, or in the group. Furthermore, they may be enhanced by the supportive interaction of the individual and the group in which he/she resides. In attempting to plan and then support meaningful, intentional learning we need to understand the context in which it develops best. Such understanding is clearly important to the management of any professional development blended learning course or event.

In their research, Graham *et al.* (2005) found that overwhelmingly academics chose blended learning for three reasons: for improved pedagogy, for increased access and flexibility and for increased cost effectiveness. The effectiveness of a blended course will be greatly influenced by the skill, enthusiasm and availability of the staff who work on it; it has been highlighted earlier in this study the reasons why they need staff development to be effective. Macdonald (2006), through presentation of a number of case studies, has shown the centrality of enthusiastic and well-trained tutors for a successful blended

course; particular challenges to be faced by all are "making the shift from face-to-face tutoring to online tutoring" (p166).

On the surface, blended learning is an intuitively obvious design approach that combines the appropriate capabilities of both face-to-face and online learning to meet the particular needs of a course or programme of studies. Educationally, blended learning has the potential to integrate immediate, spontaneous and rich verbal communication with reflective, rigorous and precise written communication, as well as visually rich media and simulations. It is not however, a natural corollary that such capabilities help meet all the disciplinary demands and needs of learners in particular disciplinary contexts.

The literature has been full of enthusiastic predictions about the potential of eLearning in higher education, offering optimistic horizons with halcyon views of online collaboration and learning; however any practitioner from the field who has designed and delivered an online course can recount negative experiences of student retention and lack of participation. According to Macdonald (2006), blended learning seems to have arisen from a general sense of disillusionment with the stand-alone adoption of online media, whose promise whilst felt by many, remained unfulfilled. As far back as 2002, Mason comments "…the earlier eLearning adopters have come full circle in rejecting an 'either or' view of learning online versus face-to-face…so called blended solutions often offer the most satisfactory outcomes." (p29). Building on this, it is argued that the choice of appropriate tutor-mediated support is vital to blended learning. Macdonald (2006) echoes Salmon's (2002) earlier call that if tutors are to be deployed in new roles, then they need appropriate training and professional development.

Central to this debate, Laurillard (2002) suggests that a balance of media is essential to make learning and teaching effective. Hofmann (2006) believes that years of academic research and conventional wisdom tell us that "the best programmes are a blend of learning technologies" (p29). Blending technologies that take advantage of learning styles, learner convenience and the best practices of instructional design are utilized to create modules that engage the learner and maximize learning retention. So, there have

been clear and persuasive messages coming from research studies about the benefits of blended learning, but at the same time, a number of criticisms have been direct towards the facilitation of blended learning experiences: some have an overemphasis on the live components with a subsequent undervaluing of the self-directed components of the blend and there have been instances of lack of experience in facilitation as a result of no formal training provision. Indeed, from a philosophical perspective it has been criticized, in particular by Offerman and Tassava (2006) who challenge the very assumptions behind blended learning as holding onto relics of an old paradigm of learning.

Arguably, eLearning has the potential of adding three new dimensions to PBL. Firstly, as an aid to carrying out work on a problem (product, presentation or performance). Secondly, as part of the content of a problem, and thirdly, as a vehicle that helps create a learning environment in which students and lecturers are both learners and facilitators of learning. With the dropout rates in eLearning environments typically being even higher than traditional learning, involving issues of isolation, disconnectedness and technological problems which are often cited as factors that influence a student to leave a course, an increased level of motivation and engagement certainly sounds like something from which students can benefit. Combining applicable technologies in such situations in which physical and temporal presence is limited, or in which the digitized technology offers real added value would seem important. The online environment offers unique opportunities for both tutors and students to analyse the collaborative problem-solving process, because there is often a written record of it left behind, which can be analysed, evaluated and reflected upon.

Designing a Blended PBL Module

There have been many claims of the positive learning outcomes that PBL allows and Salmon and Lawless (2006, p390) include some of these as open-mindedness, reflective, critical and active learning; it has been seen to reflect the nature of knowledge as complex and changing since problems are always part of a problem situation or what is problematic about a situation. The PBL approach in the module at the centre of this study also claims to incorporate such potential and can be summarised as including stages of

problem identification, deconstruction, seeking and using knowledge and experience, understanding, thinking, choosing a strategy, acting and then critically evaluating and reflecting on the action. Platitudes and vacuous generalities should be avoided and it is important to consider what assumptions lie beneath these claims.

As mentioned earlier, there is no specific recipe for mixing up the ingredients of the blend of problem-based learning adopted; the amount of face-to-face, synchronous and self-directed work is prescribed by the learning outcomes of the module itself. Online communication plays a vital role and it is blended with event-based activities, the main ones being the PBL tutorial itself and self-paced learning. However, one of the most exciting opportunities afforded by blended learning experiences and which is central to PBL is the creation of learning communities. As the development and availability of online tools for communication has led to a concomitant rise in the concept of an online community, Donnelly (2007) advocates that inherent within this is a discussion regarding the consideration of suitable technologies and media choices available in a fluid field such as academic development today. Table 1 provides a breakdown of the ingredients in the blended PBL module and estimated time for completion of each activity.

Features of a Blended PBL Environment	Duration of Activity
Face-to-face PBL tutorials	10 x 3 hours
Between tutorials: researching, reading, planning, designing ideas	Over 10 weeks
Online reflective journal entries	1 per week x 10 weeks
Video conferencing session	3 x 1 hours
Asynchronous discussions	5 per week x 10 weeks
Synchronous chat sessions	10 x 30-60 mins
International guest tutor collaboration	3 x 1 week

Table 1 Activities in the Blended PBL Module

In the module design, all aspects of blended learning including required online communication, participation and activity completion need to be considered equally as important as attending any of the live, face-to-face PBL tutorials. Otherwise, there may be a possibility of participants waiting for the live events to obtain “the important stuff”.

This blended PBL module was designed based on a model originally developed by Oliver (1999) (illustrated in Table 2).

Learning Design Elements	Description
Learning tasks	The activities, problems and interactions used to engage the learners, on which learning is based
Learning resources	The content, information, and resources with which the learners interact, upon which learning is based
Learning supports	The scaffolds, structures, encouragements, motivations, assistances and connections used to support learning

Table 2 The Three Learning Design Elements of the Blended PBL Module

The module used the 'WebCT'™, now merged with Blackboard™ course management system (VLE), which provided both asynchronous and synchronous interaction tools. For the former, the module had discussion forums where the participants posted their messages and its own email system that enabled the participants to exchange private emails. For synchronous communications, the module had 'chat rooms' where individuals exchanged instant messages at the same time. By virtue of its online setting, the module web site was accessible from anywhere and at any time. 'Marratech' software was used for video conferencing with guest tutors, and on one occasion, with a peer from the PBL group, from abroad.

As PBL is consistent with a social constructivist learning pedagogy, one of the challenges faced is to integrate eLearning technologies into PBL where it is appropriate, and where it supports the learner. Within PBL, Ronteltap and Eurelings (1997) classified PBL activities for learners into two sets and it is based upon these that eLearning technologies were integrated into the module. Information-related learning activities on the module benefit greatly from the vast array of resources available on the Internet to support the research and resource-based searching, selecting, collecting and presentation aspects of the PBL problem. It is argued that the skills of analysis and syntheses still need to be developed within the individual learner and cultivated in the PBL group. Communication and collaboration activities including peer, tutor and international guest expert communications all support the participants in their questioning, challenging and

constructing of knowledge. A third set of activities deliberately integrated into this module are reflective in nature. As a knowledge construction process with learner intention and self consciousness, Jonassen and Land (2000) suggest that learning activities need the support of reflection and self-regulated learning and the module requires that participants have both the consciousness and capability for both.

We have seen that blended PBL is a more recent term used to describe the PBL learning environment which combines several delivery methods, namely eLearning via the Internet, with a traditional face-to-face (f2f) PBL tutorial classroom. It is claimed that the module design (illustrated in Figure 1) emphasises what Uden and Beaumont (2006) have called the close alignment between PBL and ICTs, specifically in the areas of resources, interactive tasks and support. Kiser's research (2002) identifying five core elements of blended learning (use of scenario-based exercises, integration of learning objects, early use of knowledge and skills, access to live mentors and assessments mimicking real world tasks) maps onto PBL and Uden and Beaumont (2006) believe that this reinforces the argument that PBL and eLearning technology can indeed be integrated successfully to the benefit of learners. Furthermore, to summarise, they assert that:

> *the student-centred, task-focused, research-based, collaborative learning characteristics of PBL make it a particularly suitable environment in which to blend technology*. (p207)

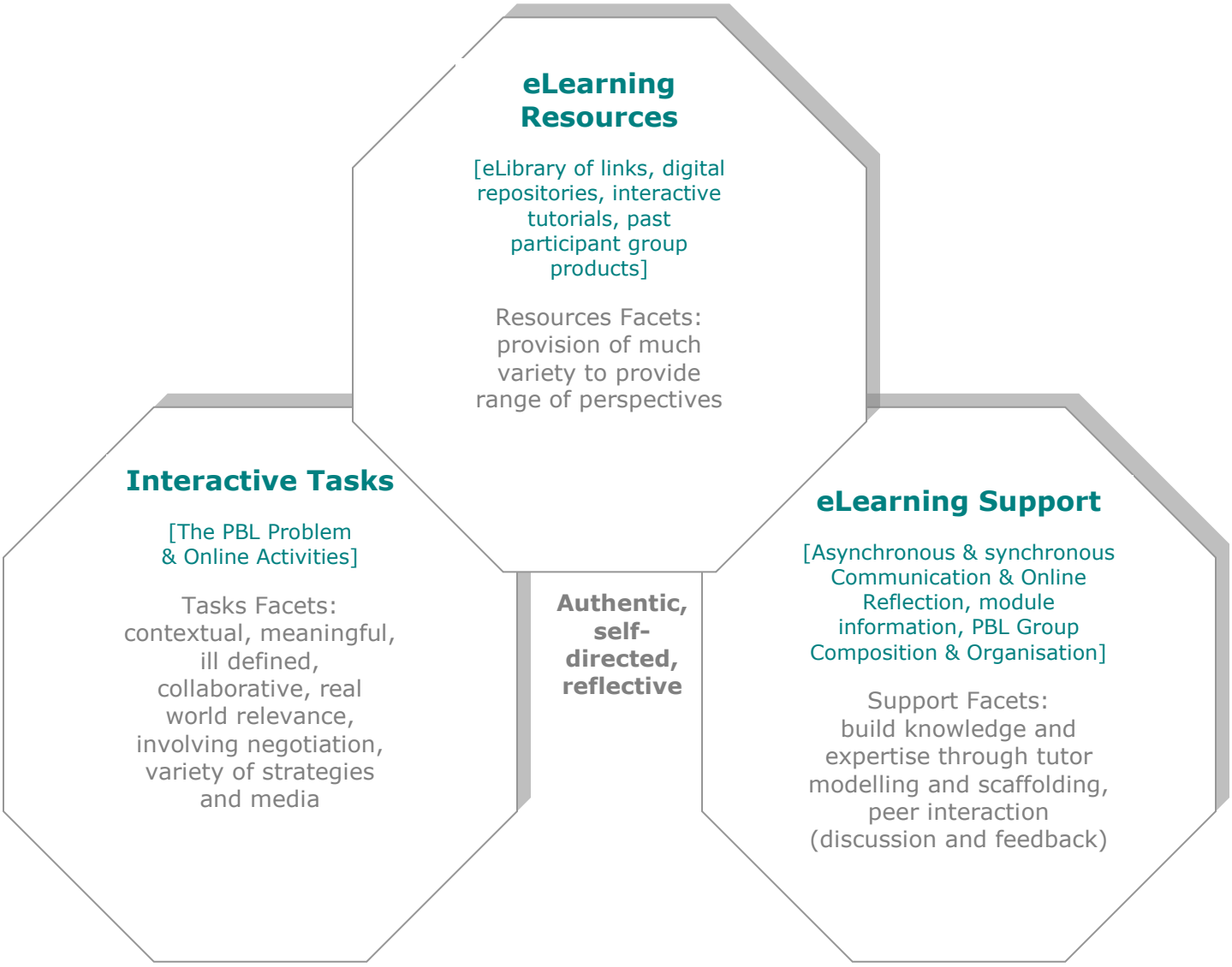

Figure 1 The Design of the Blended PBL Module

A critical factor in the success of PBL is the provision of appropriate **resources** for active research and location of information for the solving of the PBL problem. Organisational **support** information about the module includes: explanation of PBL and links to some key PBL sites; roles and responsibilities of the participants; the group composition; expectations of time to be spent online individually and in the PBL group; milestones, deliverables and deadlines for the PBL problem; negotiated group ground rules based on netiquette; a database of frequently asked questions; links to relevant interactive tutorials on web researching, interpersonal communications, conflict resolution, self and peer

assessment strategies within PBL; and participant home pages. Arguably this is a static environment so far, and the intention is to change it to a dynamic site, to complement the f2f PBL weekly tutorials and adapt to the participant group experience and progression of the PBL Problem.

It is the essentially rich environment of synchronous and asynchronous communication tools that truly support distributed (virtual) PBL. Group working and associated communication is a vital component of PBL and it is dependent on participant collaboration for its success. Again, it is argued that eLearning technology should only be used if it adds value to the existing f2f tutorial sessions. It is interesting to note that a review by Ronteltap *et al.* (2004) at the University of Maastricht, a higher education institution famed for its use of PBL, prioritised the use of communication tools because planned f2f meetings "appeared to be insufficiently supportive of the learning process" (p274). This enthusiasm has been tempered by the realisation that one of the most challenging tasks is to design and facilitate an effective communication space for any form of online learning, including PBL.

The **interactive** use of eLearning in this module is the process-supporting kind, making use of the technologies of discussion forums, chat rooms, video and audio conferencing to link to live international experts, blogging software and what Buzan and Buzan (1996) have termed mind mapping techniques, with supporting software. Building semantic links in this way represents information more visually and also uses more than one dimension. In the past, Schank *et al*. (1995) have reported other software explored by researchers which was specific to social and cognitive process support. One such example was by Koschmann *et al.* (1996), who worked on developing a comprehensive computer-supported environment for PBL. What is interesting about their work is their suggested use of technological supports needing to subtlety change pedagogy – a theme that has since been enhanced and propagated in eLearning research ever since.

Bereiter and Scardamalia (2000) picked up on ways that eLearning technology could truly add-value to the process of PBL, namely in the directive tutor's role which Donnelly

(2006a) reported as the tutor encouraging a more equal relationship with the participants, the tutor-dependent students' role and disparities in student participation and involvement. In this blended PBL model, the tutor is no longer at the centre of the communications web. The asynchronous nature of the online discussions means that participants do not have to capture a conversational turn to contribute to discussions and so it becomes less likely that a few participants will dominate. Conversely, in this same medium, the more reticent or less verbal participant may also benefit from having more time to formulate a response. Of course, such a rosy picture in itself can be misleading.

Donnelly (2004) reports from a survey of the literature, that there appears to be significant opportunity in PBL for the use of asynchronous forums. Based on this, threaded discussion postings are used on the module for posing questions, arguing positions and challenging statements, achieving consensus and co-constructing meanings about eLearning. At the same time, Donnelly and O'Rourke (2007) contend there is a plethora of research reporting difficulties generally with participation in online discussions. Particularly with campus-based students, the use of discussion forums can be regarded as an imposition by students unless they can see that the discussion relates to their study and that the discussion forum is an appropriate location and medium for the interaction. Once students are convinced of the benefits of sharing references and sources, it can galvanise the group into getting started. Palmer (1998) believes a teaching and learning space needs to be more than a form for individual expression; it must also be a place in which the group's voice is gathered and amplified, so that the group can affirm, question, challenge and correct the voice of the individual. Sustained asynchronous collaboration over time remains to this day a problematic area. Whilst learning can demand solitude, it also demands community, a dialogical exchange in which our ideas can be tested, our biases challenged, our knowledge expanded and even our ignorance aired; all of which is best served with others, rather than in an exchange in which we are simply alone with our thoughts. Alongside this, it is recognised that there is difficulty entailed in such endeavours in an online forum. Bereiter and Scardamalia (2000, p193) rightly argue that "utilising an educational approach with the high aspirations of PBL

means looking for ways to make participation cognitively more rewarding to the students".

Increasingly, there is a growing emergence of the use of synchronous forums for supporting PBL (Portimojärvi, 2006). There is little doubt that each year, newer technologies are ensuring that synchronous communication is becoming even more ubiquitous amongst students and arguably teachers need to follow suit. Some claims of preference for one medium over the other have been too hastily appropriated and in their research, Chew and Beaumont (2004) found that an integrated set of synchronous and asynchronous tools were important within a distributed PBL environment.

Resolving the tension on which medium to use seems to be a perpetual task for the educator. The fissure is particularly acute in this debate over synchronous vs. asynchronous delivery. At the turn of the century, McFerrin (1999) reported on studies highlighting the benefits of online communication by extending classroom discussions, improving interaction between student and teacher (Collins, 1998) and increasing time-management ability, self-directive behaviour, self-confidence and self-discipline. Yet today a common problem for some academic staff is that they find asynchronous facilities a hindrance rather than a help to learning. Students too are reluctant to use them in a formal academic setting for a number of reasons, in contrast to the growing popularity of social networking sites such as those provided by, for example, 'Bebo' and 'Facebook': asynchronous interaction can inhibit spontaneous development of ideas; in collaborative projects, a student may also make significant progress down the 'wrong path' through research or practice before his or her group-mates can correct an improper understanding of that student's role in the group for that particular assignment; in addition, Garrison and Anderson (2003) have reported that asynchronous interaction inhibits the quick allocation of tasks and formation of schedules to get problem-solving activities completed. Furthermore as traditional face-to-face group dynamics can still tend to be the benchmark by which the value of the learning-teaching experience is judged, online pedagogies are frequently valued by academic staff only in proportion to how well they seem to reproduce or simulate an equivalent face-to-face experience. Where this fails (as it often

does) lecturers may revert to using the VLE as a method for distributing lecture notes, or may simply abandon using it altogether. Figure 2 overleaf shows the implementation of the blended PBL model of academic development proposed in this study. Colour is used to show at a glance those components that are face-to-face (outlined in green), those that are fully online (outlined in blue) and the blended components (outlined in purple). The WebCT courseware management system is highlighted in grey. The discourse in the PBL tutorial is supported with activities such as guided reflection, guest seminars, demonstrations of the technologies and peer evaluation. The online components of the blend include some course management standard features such as student homepages, online timetables and a set of personal individual progress statistics. These are augmented by virtual PBL tutorials which encompass online activities such as discussions, presentations, formative assessments and delivered using a set of tools such as video conferencing, podcasting, discussion forums, chat rooms and interactive tutorials.

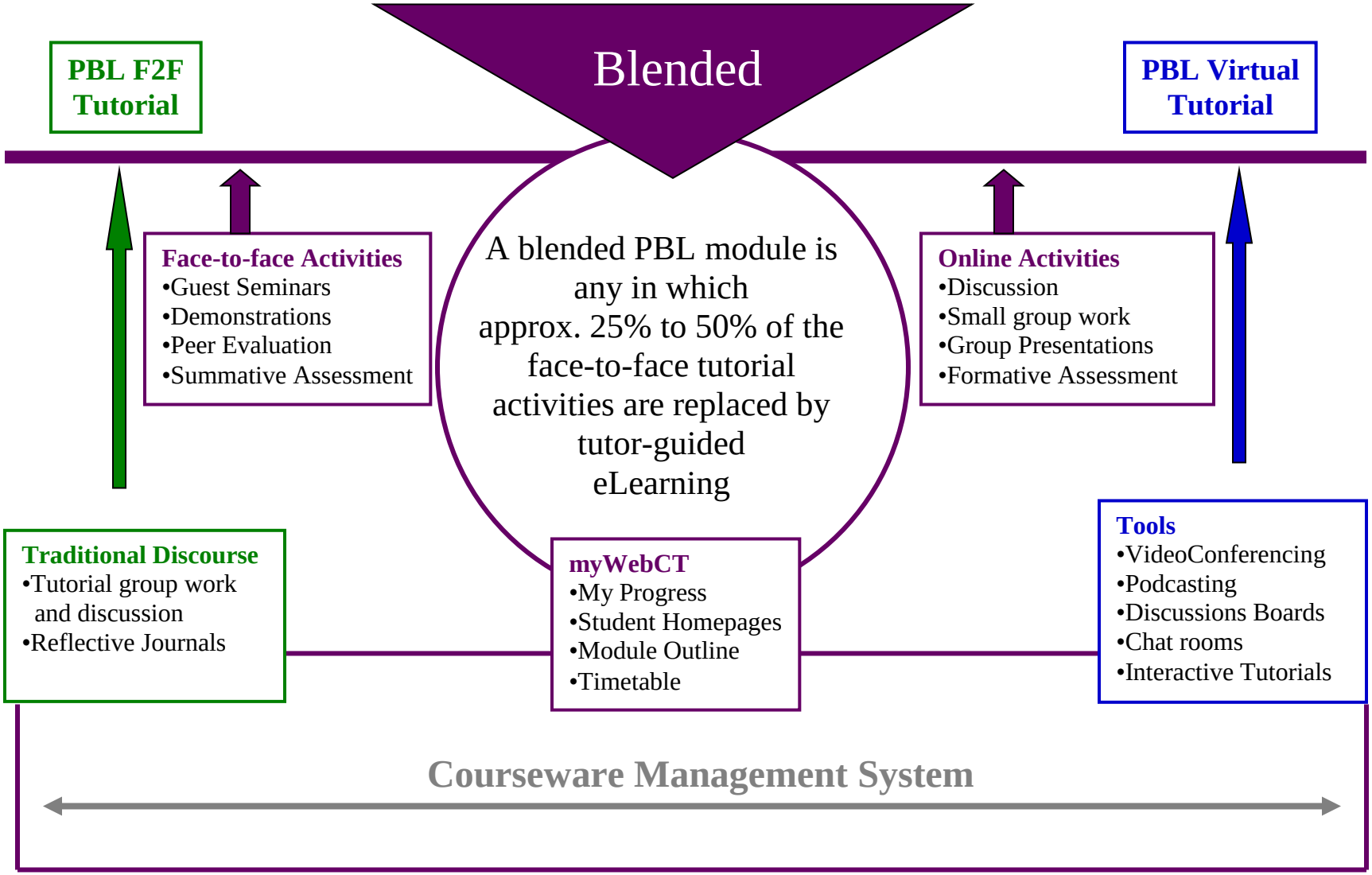

Figure 2 The Implementation of the Blended PBL Module

How Interaction Features in the Module

Graham (2006) offers up six major issues which are relevant to designing any form of blended learning systems: the role of learner choice and self-regulation, models for support and training, finding a balance between innovation and production, cultural adaptation and dealing with the digital divide and significantly for this current study, the role of live interaction. Yoon (2003) suggests that online interactions which can be stored, retrieved and disseminated anytime, anywhere are still a relatively new phenomenon and awaits greater exploration and coordination.

From a constructivist viewpoint, studies on web-based learning environments have shown that a critical component to interaction online is an interpersonal, social component; this occurs when learners receive feedback from the instructor or peers and colleagues in the form of personal encouragement and motivational assistance. Social interaction can contribute to learner satisfaction and frequency of interaction in an online learning environment. Indeed, Grabinger and Dunlap (2000) have reported that without the opportunity actively to interact and exchange ideas with each other and the instructor, learners' social as well as cognitive involvement in the learning environment is diminished.

For the purposes of this study, interactions are defined as reciprocal events that require at least two objects and two actions. Interactions occur when the objects and events mutually influence one another. A number of schools of thought have emerged in the last two decades that explore interaction in the context of technology-mediated learning. There are two commonly held beliefs. Firstly that the perceived quality of a learning experience is directly proportional to and positively correlated with the degree to which that experience is seen as interactive. Secondly, if technology-mediated learning designs are to have any significant impact on current and future pedagogical practices, then learning design decisions need to maximize the benefit of interaction.

Interaction has long been regarded as the vital ingredient on which success matters in technology-related education. Research studies by Frankola (2001) and Charp (2002) on

attrition rates in online courses has provided a rationale for the emphasis on promoting interaction and sound instructional strategies in online courses. More recently, Yun (2005) has concluded that there is evidence that instructional strategies which incorporate various types of interaction can be the key to teaching a high-quality online course that engages students. Student perceptions also provide a reason why interactivity is important in eLearning. A number of studies have shown that students tend to judge a distance education course according to their perception of the instructor-student interaction (Abbey, 2000; Flottechmesch 2000; Lynch 2002).

According to Vygotsky's social development theory, learning does not happen in isolation. A number of respected scholars including Ramsden (1988), Garrison (1990), Entwistle and Entwistle (1991) and Wagner (1994) have reported that increased levels of interaction have been shown to increase motivation, positive attitudes toward learning, higher satisfaction with instruction, deeper, more meaningful learning and higher achievement. Owsten *et al*. (2006) believe "sustained interaction between and amongst tutor and students leading to knowledge construction and validation requires an opportunity to share and test ideas in a secure environment and with a manageable number of students" (p339). ICTs have both the capability of supporting and enhancing this engagement and the capacity to extend the learning experience to critically consider the digitized technology itself and critically access and evaluate the wealth of information available in a virtual learning environment.

Interaction in education is a complex phenomenon. The literature identifies several taxonomies that classify various types of online interactions; however, Moore's (1989) seems to be the most well known taxonomy in the field of online education where he described three types of interaction: learner-content, learner-instructor, and learner-learner, which were later extended by Hillman *et al*. (1994) to include learner-interface interaction. Many other definitions of interaction exist (Weller 1988; Merrill, Li and Jones, 1990; Wagner 1994; Carlson and Reepman, 1999; Hirumi, 2002; Sims 2003; Yun 2005) and all provide a variety of reasons why interactivity in an online course is important. Wagner (2006) has discussed the concept of interaction in relation to blended

learning and it is considered that this adequately serves as a demonstration of the breadth and vitality of the field. He contends that interaction should be viewed less as a theoretical construct and more as a variable that needed to be exploited, accommodated, leveraged or managed when crafting blended learning designs. Interactions have been researched in terms of four dimensions: transactions (interpersonal, academic, collaborative), outcomes, social presence and experience.

Each of the four dimensions of interaction provide very different views on the value that interaction brings to a learning experience. They also share a number of similarities. Firstly, each perspective is shaped by some degree of technology-mediated learning and is looking for a way to transcend distance. Secondly, each assumes some degree of self-regulation and independence on the part of the learner. Thirdly, each acknowledges the value of facilitation by a tutor. In the context of this present study, this suggests that interaction strategies, regardless of their theoretical bases, can help improve the relevancy of blended PBL experiences for the participant. Table 3 (overleaf) depicts the variables of blended learning interactions central to this study in terms of their attributes and function; they have been considered for the work as they are central to the social and communal constructivist approach adopted in the module.

Variable	Attributes	Function	Contribution of my Study: Theory into Practice
Interactions as transactions	Learner collaboration	is the degree and quality of engagement with others	- Creation and sharing of ideas - Critiquing ideas - Deciding and agreeing to collaborate on an issue
Interactions as outcomes	Interaction for participation	Provides learners with a means of engaging with one another	Articulating one's interest in assuming leadership responsibilities in a group
	Interaction for communication	Offers the ability to share information and opinions or to influence intentionally the opinions or beliefs of others	Teaching others in the group
	Interaction for negotiation	Involves the willingness of another individual to engage in a dialogue, come to consensus or agree to conform to terms of an agreement	- Initiate dialogue with peers or the tutor - Dialogue on how they will agree on an issue
	Interaction for teambuilding	This is necessary to ensure that individual members of a team/group actively support the goals of the group	- Recognition and acceptance of individual differences - Expression of respect for the group as well as for its members - Effective listening - Shared sense of responsibility - Confirmation of expectations within the group

Table 3 Blended Learning Interactions Central to this Study

Future Trends

The fundamental activities of design, creation, implementation and research concerning learning processes supported by digitized technologies poses a unique set of challenges for both educators and the academic developers charged with promoting and enhancing the professional development of these academic staff in higher education today.

A platform is required for the research of higher education, and learning and teaching in particular. The research on blending eLearning and pedagogies such as PBL are certainly continuing apace today. In order to accelerate the socio-technological benefits of eLearning, the design of transformative learning into the future needs to take account of both the unprecedented access to educational resources and the range of mentors, international experts and online activities required for success.

Conclusion

The Web is a prime example of a socio-technical network. We cannot understand the potential of the Web in isolation. The potential of the web exists only in the context of the potential of society. Each can help the other work for a more attractive future. The central issue is to provide the social mechanisms and the technical support to try to ensure that the relationship is both helpful to large numbers of learners, and that it both reflects and helps achieve their aspirations in higher education in this new millennium.

Intensive and comprehensive staff development programmes, one of which was the subject of this research, can be effective in transforming teachers' beliefs about teaching and learning. The growth in such programmes relating to academic practice may be the best way forward for real cultural change and fundamental changes in teachers' beliefs about teaching with technology can come from extensive reflection on practice and exposure to appropriate socio-technological models.

This paper has suggested that the benefits of interaction in the blended PBL tutorial are achieved through small-group work both online and face-to-face. The literature widely mentions a communicative approach and cooperative and collaborative learning as

methods that encourage an active and constructive learning and enhance the learner's autonomy, self-esteem and intrinsic motivation to learn. Collaborative learning is based on knowledge building that is possible thanks to the opportunities the participants have for real communication between themselves and the tutors. From the arguments presented in this paper about interaction in a blended environment, transformative learning is used as the starting point for an investigation for new ways of planning blended learning events for academic staff into the future.

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